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ERP Software Selection Model for Small and Medium-Sized in Retail Sector Using Analytic Network Process

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ABSTRACT

Small and medium sized (SME) retailers strive to maintain the balance of demand and supply in their stores. By maintaining the availability of items, they able to provide positive shopping experience for customers. Therefore, they are able to survive in a competition with large retailers. The technological advances and the shopping behavior are among the factors that encourage SME retailers to adopt the technology information system for supports information between business functions to keep the balance of supply, demand and their distribution. One of the many ways to maintain balance of demand and supply is by implementing Enterprise Resource Planning (ERP) (). However, ERP is quite difficult for SME retailers to be implemented in their organization. Selecting the optimal ERP software is a critical process in the early phase of an ERP project. This study aimed to investigating the priority (preference) of the criteria and alternatives using the Analytic Network Process (ANP) approach for the small and medium-sized retailers focusing in Jakarta. This study conducted by observation and interviews with the experts who have experience with ERP and small and medium-sized retailers. In this study, the pairwise comparisons used to assess the proposed alternatives and criteria. Furthermore, this study also calculates the overall score of the criteria and alternatives for analyzing the relation and preference of the criteria and alternatives. The theory of ANP used to evaluate all criteria and alternatives with expressed numerically. The findings of this study provide an overview that small and medium-sized retail companies tend to require systems or ERP software. In this study, there are 5 criteria most preferred: ease of customization, technical aspects, functionality and compatibility with other systems, and software prices. These criteria are considered to ensure the good operational activities. The most preferred alternative is SAP Business One, as it scored highest on several criteria, Odoo and Acumatica. The limitation of this study is that this study only used three ERP software programs as alternatives and this study focuses only for the small and medium-sized retailers in Jakarta.

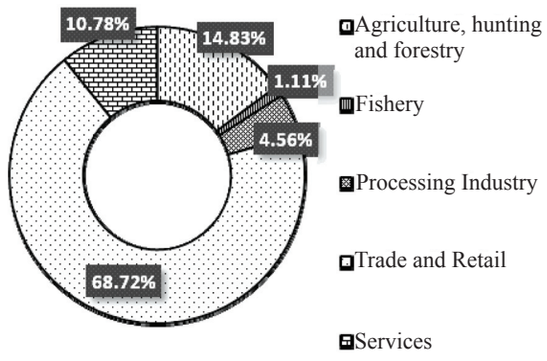
Keyword: Enterprise Resource Planning (ERP); Analytic Network Process (ANP); Retail; Small and Medium –Sized Enterprise (SMEs).

INTRODUCTION

Levy and Weitz (2001) stated that retail is a business activity to provide added value of products and services due to personal or family needs. Often people think retail product is sales in the stores, but retail activities also involve services such as a motel, haircuts, DVD rental, or pizza delivery. The retail business is an attempt being made to sell goods or services direct to buyer.

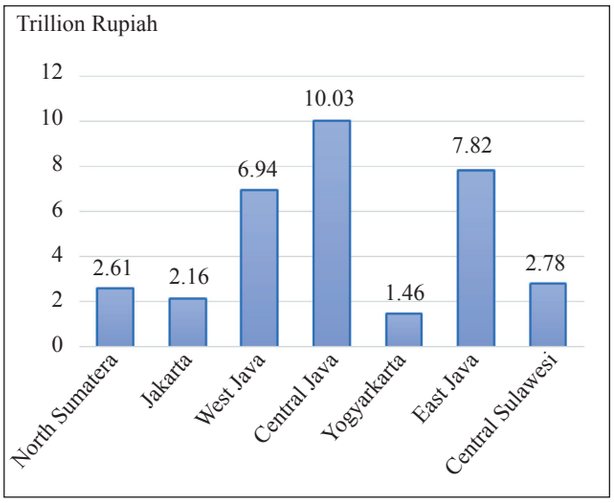
Mandiri Institute (2016), stated that Indonesia's retail market has long term potential. National retail growth ahead caused by demographics of Indonesia is dominated by the young age. It will increase the number of productive labor, changes in lifestyle and consumption patterns of middle-income society that still continues to grow. The increasing population of middle-income society will provide a significant impact for the development of the retail industry. Therefore, the potential of the retail business will continue to grow in Indonesia.

According to data from trian Koordinator Bidang Perekonomian (the Coordinating Minister for Economic), the realization of KUR (People Business Credit Program) in Indonesia in July 2016 stated that the realization of KUR for small and medium-sized enterprises is dominated by trade and retail sectors (68.72%) are shown in Figure 1.



Source: Kementrian Koordinator Bidang Perekonomian 2016

FIGURE 1. Realization of KUR based on sectors



Source: Kementrian Koordinator Bidang Perekonomian, 2016

FIGURE 2. Realization of KUR based on provinces

Awareness of the demands of the more modern retail management, technological advances and the shopping behavior that lead many small and medium-sized retailers to adopt the technology information system for supports information between business functions to keep the balance of supply, demand and their distribution. Deros et al. (2007) stated that the most important success factors of SMEs are top management leadership and customer satisfaction management. Therefore, small and medium-sized enterprises not only have to build the good leadership and human resource but also they have to provide and improve the customer satisfaction. Small and medium-sized retailers need to adopt information systems. The integration of information across the business functions able to keep the balance of supply, demand and their distribution. It aims to maintain the availability of items, so their customers able to get what they need with good quality at the right time. The customer loyalty will grow when the customers have a positive shopping experience. Thus, the small and medium retailers will be able to survive the competition against large retailers.

Monk and Wagner (2013) stated that the Enterprise Resource Planning system (ERP) are core software programs used by companies to integrate information in every area of the business. ERP helps organizations that manage business processes, most of ERP systems use a common database and reporting tools for reports or forecasting. Garg (2010) stated that the implementation of the ERP is begin with the choice of ERP software. Implementation of ERP is complex and need to perform analysis for selecting ERP. Gurbuz et al. (2012) stated that the approach of the ANP is very useful in this situation. It provides a general framework without assumptions of independence from elements from the higher or lower level or in the same level. The super matrix is used to get the value of composite that overcomes the existing interrelationships. ANP is able to analyze criteria and sub-criteria of ERP software to determine the behavior of conjunctive and disjunctive between the cluster and its components.

This study aimed to investigatie the priority (preference) of the criteria and alternatives by using the Analytic Network Process (ANP) approach for the SME retailers especially in Jakarta. This study conducted by observation and interviews with the experts who have experience with ERP and SME retailers in Jakarta. In this study, the pairwise comparisons used to assess the proposed alternatives and criteria. Furthermore, this study also calculates the overall score of the criteria and alternatives for analyzing the relation and preference of the criteria and alternatives.

LITERATURE REVIEW

Dinesh and Vetrivel (2013) state that an Enterprise Resource Planning (ERP) system helps the retailers manage their businesses in an effective and efficient manner by providing integrated and consistent information flow. They have become indispensable tools to survive and increase profitability in the retail sector for large retail organizations.

Leyh (2016) state that the implementation of an information system (e.g. an ERP system) is a complex and time-consuming project during which companies face great opportunities, but at the same time also face enormous risks. So, research of CSFs (Critical Success Factors) provides valuable information that may enhance the degree to which an organization's implementation project succeeds. As a first step, the study needs to carry out a literature review to identify CSFs and to update existing reviews. Here, the factors ERP system tests and Organizational fit of the ERP system as the most important factors as well as ERP system configuration that is also part of the top 10 factors refer to more technological aspects. Hence, factors with an organizational characteristic could also be identified as part of the top five factors in the study, which are>>> (Balanced project team, Project management, and Change management).

Gurbuz et al. (2012) explain ANP is comparison matrices, prioritization and the weights while considering the interdependencies are formed between various attributes of each level with the scale of 1–9 suggested by Saaty (2001). ANP is used to assess the alternatives according to all the criteria, calculate an overall score for alternatives and make a final decision to choose the best alternative or priority of alternatives. Konakli (2014) explains the relevant factors and how significant their influence is on the selection of ERP software. These factors are analyzed and assessed based on the survey results. Then, these factors are used as criteria based on the correlation with the ERP software selection. Hidalgo et al. (2011) describe the selection of ERP software in the metal transformation sector using the AHP. Selection of ERP software uses a number of criteria that directly affect the process in assisting managers in making decisions.

The Analytic Network Process (ANP) is a generalization of the Analytic Hierarchy Process (AHP). The basic structure is an influence network of clusters and nodes contained within the clusters. Priorities are established in the same way they are in the AHP using pairwise comparisons and judgment.

Not only does the importance of the criteria determine the importance of the alternatives as in a hierarchy, but the importance of the alternatives themselves also determines the importance of the criteria (Saaty 2001).

METHODOLOGY

A combination of qualitative and quantitative research methods was used in this study. The quantitative process is carried out by assessing the ANP questionnaire (pairwise comparisons) and the qualitative process by conducting interviews. The proposed ANP model, criteria, sub-criteria and alternatives for selecting ERP software were developed based on literature review on ERP software selection and considering input from respondents.

This study begins by identifying the ERP selection criteria derived from previous studies and then the describes the criteria referring from the system requirements and character of ERP for small and medium-sized retail enterprises in accordance with the respondents' considerations. Afterward, it defines the proposed decision framework model and then respondents assess the pairwise comparisons questionnaire (ANP). In this study, selecting ERP software and considering inputs were based on the knowledge of experts (respondents) on the implementation of ERP software especially in retail companies. In this study, there were five respondents from three competencies: three ERP consultants, one retailer internal consultant and one academic.

PROPOSED ELEMENTS

In this study, the selection criteria were obtained by modifying previous studies and discussing with respondents. Some studies are used as references (Gurbuz et al. (2012); Medeiros et al. (2014); Vahidi et al. (2014); Hegazy et al. (2012); Demirtas et al. (2011); Tolga (2011); Konalki (2014)). Each previous study had considerations and respective criteria proposed in the selection of ERP software. The comparison of many criteria based on previous studies shown in Table 1.

TABLE 1. List of ERP Criteria

No	Previous Studies Sector	Gurbuz et al. (2012) no specific sector	Medeiros et al. (2014) no specific sector	Vahidi et al. (2014) no specific sector	Hegazy et al. (2012) no specific sector	Demirtas et al. (2011) transportation sector	Tolga (2011) no specific sector	Konalki (2014) no specific sector
1	*Functionality*	x	x	x	x		x	
2	*Technical Aspect*	x	x		x	x	x	x
3	*Software price*	x	x	x	x	x		x
4	*Maintenance Cost*	x	x	x	x			x
5	*Service and Support*	x	x			x	x	x
6	*Compatibility with other system*	x	x		x	x		
7	*Easy of Customization*	x	x		x		x	x
8	*Market Position of the vendor*	x						x
9	*Domain Knowledge of the vendor*	x						
10	*User Friendly*				x			x

The elements of criteria were proposed based on discussion with the expert who have experience to implement ERP in small and medium-sized retailers and added with previous studies as reference. Gurbuz (2012) presents there are 3 groups of criteria such as related of customer, related of vendors and related software which is then divided into several sub-criteria. Medeiros et al. (2014) in his research exposing 4 grouping criteria based upon a model to analyze the strategic alignment of IT with the corporate strategy developed by Henderson & Venkatraman (1993) which were comprised of Business Strategy, IT Strategy, Organizational Infrastructure and Information Technology Infrastructure and Processes which are then divided into many sub-criteria. The valuable information that may enhance an organization's implementation project succeeds. As a first step, the study needs to carry out a literature review to identify CSFs and to update existing reviews (Leyh, 2016). In this study, the system requirements were proposed based on CSFs and criteria of ERP from previous study. After the points of requirements are collected then the points are discussed with the respondents. The proposed requirements are shown in Table 2.

Based on advice from respondents regarding the system requirements and characteristics of retail SMEs, this study defines the description of each criterion shown in Table 3.

PROPOSED DECISION FRAMEWORK

This study proposed many criteria: Functionality, Technical Aspect, Software Price, Maintenance Cost, Service and Support, Compatibility with Other Systems, Ease of Customization, Market Position of the Vendor, and Domain Knowledge of the Vendor. Then, these criteria were grouped

TABLE 2. Proposed Requirements

	CSF (Critical Success Factors)	Standard	Criteria of ERP
Organizational Fit	The ERP system must be accordance with the business process, business functions and organizations.	The main functions: *-Purchasing (PO, Goods Receipt)* *-MRP* *-Inventory and warehousing* *-Financials (invoicing, payment)* and other additional function such as ritail POS, *Purchase Quotation* and *Asset Management*.	*Functionality* *Domain Knowledge of Vendor*
	The ERP system must be in accordance with the infrastructure and environment of ICT.	The technical aspect should be easy to handle because of limited infrastructure and IT personnel.	*Technical Aspect*
Project Management	The main functions: The state of human resources.	The Company need excellent support and services because of limited knowledge of employees regarding the implementation and operation of ERP.	*Service and Support*
	Participation and enthusiastic team and employees.	The market position and reputable of ERP vendors can affect the team to participate in the ERP implementation.	*Market Position of Vendor*
Change Management	Participation of team members in the system changes.	The system should be easy to use, thus reducing the resistance to changes.	*User Friendly*
Clear Goal and Objective	Clear goal and purpose of implementation.	Integrating all business functions of the company.	*Compability with Other system*
Top Management Support	Commitment of management to prepare resources including financial resources.	Business owners considering to use Software ERP license and costs of maintenance.	Software Price *Maintenance Cost*
System Configuration	Adaptation and configuration according to the needs of the company. The system can be integrated with other Systems from other vendor such as POS, CRM, e-commerce and retail management software.	There are reporting, form and query tools to edit and customization.	*Ease of Customization* *Compability with Other system.*

TABLE 3. Description of Criteria

No	Criteria	Description
1	*Functionality*	to accommodate the functional area, flexible and adaptable to the functional needs for small-medium retailers, comprehensive financial function and purchasing and inventory/warehousing.
2	*Technical Aspect*	Because of rapid technological change, the dimensional technology to be important. Therefore, the system should be up-to-date with ICT trends, especially those related to database management systems, client-server environment, hardware, and operating systems. Small-medium retailers require simple and inexpensive technical aspects of the system a due to limited technology and human resources.
3	*Software Price*	Price of an ERP software including price of software and license fees.
4	*Maintenance Cost*	The cost to be paid by the company to obtain the services and support of the ERP vendor.
5	*Service and Support*	Related services and support from the ERP vendor or from a partner are an important factor in the success of the company's business.
6	*Compatibility with other system*	It means having compatibility with other systems or being able to be integrated with other systems such as POS (Point of Sales) software and other retail management software programs.
7	*Easy of Customization*	The software should be easy to customize especially in financial reporting and logistics, the retail company requires reporting of financial transactions and logistics.
8	*Market Position of the vendor*	It means, the ERP vendor's place in consumers' minds regarding the vendor's competition.
9	*Domain Knowledge of the vendor*	The information on the ERP business segmentation of the retail company's business.
10	*User Friendly*	To reduce resistance in the implementation and use of ERP software. The software ERP which easier to use has a higher value.

into 4 categories (Corporate Contribution, User Orientation, Operational Excellence and Future Orientation). Furthermore, this study used three alternatives as a sample of the ERP software, namely SAP Business One, Acumatica and Odoo.

The ERP software selection frame is designed by modifying the criteria that have been collected from previous studies and grouped into 4 categories. Afterward, the ERP software selection frame is arranged in the Super Decision software and the design of the ANP questionnaire was produced by the Super Decision software. The design of the selection framework is shown in Figure 3:

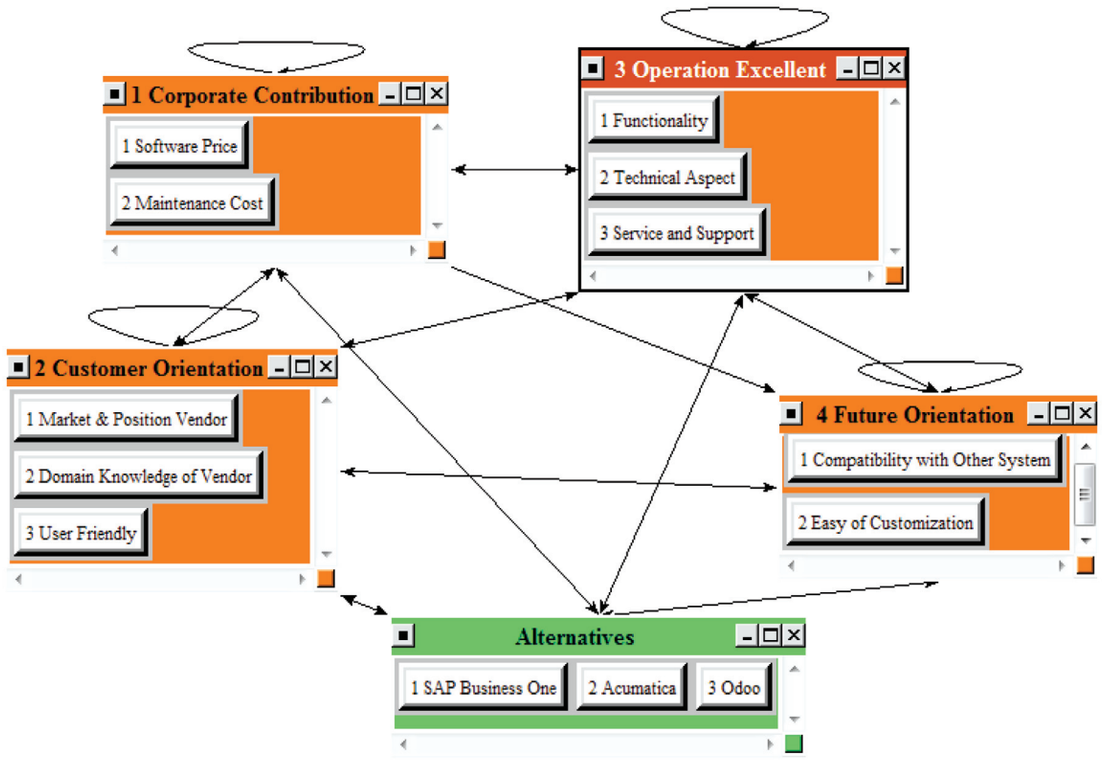


FIGURE 3. ERP software selection framework

The decision framework has been designed for analyzing dependences among criteria and alternatives (Figure 3). The cluster have inner-dependencies and outer-dependencies among their nodes (criteria and alternatives). For example, Cluster Future Orientation has two criteria (compatibility with other system and easy of customization).

These criteria have a dependence relation where compatibility with other systems helps ERP software to be easily customized. Furthermore, the framework are also used as a basis of pairwise comparison to assess the dependency relation among criteria and alternatives.

RESULT

INCONSISTENCY

After the questionnaires of pairwise comparisons were obtained, the measurement of inconsistency matrix is carried out. The measurement of inconsistency must be carried out till the assessment results obtained have a consistent value. Results with inconsistent values are not recommended for the ANP method. The data of pairwise comparison have been calculated using Super Decisions to generate information of inconsistency. The results have shown that the data is consistent, so that the data is feasible to use for the ANP method. The result is shown in Table 4.

CLUSTER MATRIX

The pairwise comparisons have been assessed to analyze the importance and impact among elements for the ERP software selection. An interpretation of priority in the alternative column shows the dependency relation of the alternatives. This study found that the cluster of Operational Excellence (0.405) is the most important factor for alternative selection.

SUPER MATRIX

The Unweighted Super Matrix has been obtained from pairwise comparisons among nodes. The column of the nodes contains the priority of all the nodes that have been compared in pairs by observing the relationships and

TABLE 4. Inconsistency

No	Respect to	Cluster	Inconsistency	Status
1	*Corporate Contribution*		0,069	Consistent
2	*Customer Orientation*		0,060	Consistent
3	*Operational Excellence*		0,055	Consistent
4	*Future Orientation*		0,023	Consistent
5	*Software Price*	*Operational Excellence*	0	Consistent
		Alternatives	0,002	Consistent
6	*Maintenance Cost*	*Alternatives*	0,018	Consistent
7	*Market Position of Vendor*	*Operational Excellence*	0	Consistent
		Future Orientation	0	Consistent
		Alternatives	0,031	Consistent
8	*Domain Knowledge of Vendor*	*Alternatives*	0	Consistent
9	*User Friendly*	*Operational Excellence*	0,052	Consistent
		Future Orientation	0	Consistent
		Alternatives	0	Consistent
10	*Functionality*	*Future Orientation*	0	Consistent
		Alternatives	0,018	Consistent
11	*Technical Aspect*	*Future Orientation*	0	Consistent
		Alternatives	0,052	Consistent
12	*Service and Support*	*Alternatives*	0,031	Consistent
13	*Compatibility with Other Systems*	*Alternatives*	0	Consistent
14	*Ease of Customization*	*Operational Excellence*	0	Consistent
		Alternatives	0,018	Consistent

TABLE 5. Cluster Matrix

Cluster Label	Coorporate Contribution	User Orientation	Operational Excellence	Future Orientation	Alternatives Alternatives
Corporate Contribution	0,565	0,087	0,103	0,000	0,156
User Orientation	0,067	0,604	0,081	0,104	0,127
Operational Excellence	0,184	0,146	0,629	0,401	0,405
Future Orientation	0,152	0,130	0,148	0,415	0,312
Alternatives	0,032	0,034	0,039	0,080	0,000

influence on the selection of ERP software. The Unweighted Supermatrix as shown in Table 6.The Weighted Supermatrix has been obtained by multiplying each entry of unweighted supermatrix with weights on the cluster matrix until each column matrix of weighted supermatrix has a total value of 1 (one) in each column. The weighted Supermatrix as shown in Table 7.

RESULT

The Limit Supermatrix has been obtained by multiplying the weighted supermatrix with itself to give a constant value. Afterward, the relativity and importance of the criteria and alternatives were collected and then normalized.

The last stage is to calculate the weight of each criterion on the result of the limit supermatrix. This stage generates scores (weight values) for each criterion (shown in Table 8) and alternative (shown in Table 9) of ERP software for small and medium-sized retailers.

CONCLUSION

The ANP (Analytic Network Process) was used in this study. The ANP method produced the priority of criteria and alternatives regarding the selection of ERP software for small and medium–sized enterprises in the retail sector. Operational Excellence has the strongest influence in the selection of alternatives, as the respondents believe that the successful operation of ERP software is the most important issue in an enterprise's business process. Ease of Customization as the most important cluster of criteria. The most of respondents consider the small and medium – sized retail companies tend to desire a flexible system with criteria i.e. easy to customize, uncomplicated the technical aspects, good functionality, able to be integrated with other systems and inexpensive price in order to meet operational needs. Most of small and medium-sized retailers in Jakarta need a flexible but consistent system due to dynamic customer habits. Generally, they integrate their ERP systems with additional software such as POS (Point of Sales) and CRM software for retail activities and to increase customer satisfaction. SAP Business One has the highest score, it has the highest scores in most of criteria

TABLE 6. Unweighted Supermatrix

		Co		*Usr*			*Op*			*Ft*		*Alternatives*		
		SP	*MC*	*MPV*	*DKV*	*UF*	*F*	*TA*	*S&S*	*CwOS*	*EC*	*SAP Business One*	*Acumatica*	*Odoo*
Co	*SP*	0,000	1,000	1,000	0,000	0,000	1,000	1,000	0,000	0,000	0,000	0,500	0,500	0,750
	MC	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,500	0,500	0,250
Usr	*MPV*	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,550	0,210	0,122
	DKV	0,000	0,000	1,000	0,000	0,000	1,000	0,000	1,000	1,000	1,000	0,210	0,550	0,320
	UF	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,240	0,240	0,558
Op	*F*	0,750	0,000	0,250	0,000	0,413	0,000	0,000	0,000	0,000	0,429	0,540	0,500	0,550
	TA	0,250	0,000	0,000	0,000	0,260	0,000	0,000	1,000	1,000	0,429	0,163	0,250	0,210
	S&S	0,000	1,000	0,750	0,000	0,327	0,000	0,000	0,000	0,000	0,143	0,297	0,250	0,240
Ft	*CwOS*	1,000	0,000	0,500	0,000	0,667	0,500	0,333	0,000	0,000	0,000	0,500	0,500	0,500
	EC	0,000	0,000	0,500	0,000	0,333	0,500	0,667	1,000	1,000	0,000	0,500	0,500	0,500
Alternatives	*SAP Business One*	0,115	0,137	0,758	0,667	0,167	0,710	0,474	0,705	0,714	0,625	0,000	0,000	0,000
	Acumatica	0,121	0,238	0,091	0,167	0,167	0,155	0,376	0,211	0,143	0,137	0,000	0,000	0,000
	Odoo	0,764	0,625	0,151	0,167	0,667	0,135	0,149	0,084	0,143	0,238	0,000	0,000	0,000

TABLE 7. Weighted Supermatrix

		Co		*Usr*			*Op*			*Ft*		*Alternatives*		
		SP	*MC*	*MPV*	*DKV*	*UF*	*F*	*TA*	*S&S*	*CwOS*	*EC*	*SAP Business One*	*Acumatica*	*Odoo*
Co	*SP*	0,000	0,724	0,087	0,000	0,000	0,277	0,355	0,000	0,000	0,000	0,078	0,078	0,117
	MC	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,078	0,078	0,039
Usr	*MPV*	0,154	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,070	0,027	0,015
	DKV	0,000	0,000	0,604	0,000	0,000	0,219	0,000	0,090	0,104	0,178	0,027	0,070	0,040
	UF	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,030	0,030	0,071
Op	*F*	0,317	0,000	0,036	0,000	0,195	0,000	0,000	0,000	0,000	0,294	0,218	0,202	0,223
	TA	0,106	0,000	0,000	0,000	0,123	0,000	0,000	0,701	0,401	0,294	0,066	0,101	0,085
	S&S	0,000	0,235	0,109	0,000	0,154	0,000	0,000	0,000	0,000	0,098	0,120	0,101	0,097
Ft	*CwOS*	0,349	0,000	0,065	0,000	0,280	0,199	0,170	0,000	0,000	0,000	0,156	0,156	0,156
	EC	0,000	0,000	0,065	0,000	0,140	0,199	0,340	0,165	0,415	0,000	0,156	0,156	0,156
Alternative	*SAP Business One*	0,008	0,006	0,026	0,667	0,018	0,075	0,064	0,031	0,057	0,085	0,000	0,000	0,000
	Acumatica	0,009	0,010	0,003	0,167	0,018	0,016	0,051	0,009	0,011	0,019	0,000	0,000	0,000
	Odoo	0,056	0,026	0,005	0,167	0,073	0,014	0,020	0,004	0,011	0,032	0,000	0,000	0,000
Total of Column		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

TABLE 8. Priority of Criteria

	Name	Normalized By Cluster	Limiting	Priority per cluster	Priority
CORPORATE CONTRIBUTION					
1	Software Price	0,904	0,111	1	5
2	Maintenance Cost	0,096	0,012	2	9
	Total Corporate Contribution	1,000	0,123		
USER ORIENTATION					
1	Market & Position Vendor	0,206	0,026	2	8
2	Domain Knowledge of Vendor	0,742	0,092	1	6
3	User Friendly	0,052	0,006	3	10
	Total User orientation	1,000	0,124		
OPERATIONAL EXCELLENCE					
1	Functionality	0,389	0,120	2	3
2	Technical Aspect	0,478	0,148	1	2
3	Service and Support	0,132	0,041	3	7
	Total Operation Excellence	1,000	0,309		
FUTURE ORIENTATION					
1	Compatibility with Other System	0,426	0,118	2	4
2	Ease of Customization	0,574	0,159	1	1
	Total Future Orientation	1,000	0,276		

TABLE 9. Priority of Alternatives

	Name	Normalized By Cluster	Limiting	Priority
ALTERNATIVES				
1	SAP Business One	0,615	0,103	1
2	Acumatica	0,184	0,031	3
3	Odoo	0,202	0,034	2
	Total Alternatives	1,000	0,168	

including Market Position of the Vendor, Domain Knowledge of Vendors, Functionality, Technical Aspect, Service Support, Compatibility with Other Systems and Easy Customization. However, Odoo has the highest scores in some criteria such as Software Price, Cost and User Friendly Maintenance.

LIMITATION

This study has used only three ERP softwares as alternatives based on discussion with respondents. It focuses only for the small and medium-sized retailers in Jakarta. Moreover, this study have not describe the process of the selection of ERP consultants (partners of the vendor). Therefore, this research should be improved to be used for various sectors and more alternatives of ERP software.

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